

THE UTILISATION OF SIX METRE COUNTRYSIDE STEWARDSHIP
SCHEME GRASS MARGINS BY THE GATEKEEPER *PYRONIA*
TITHONUS (L.) (LEP.: NYMPHALIDAE)

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Abstract

The utilisation of six metre Countryside Stewardship Scheme (CSS) grass margins by *Pyronia tithonus* (L.) (Lep.: Nymphalidae) was investigated at two farms in Essex between 1997 and 2000. At Writtle, significantly more *P. tithonus* were seen on the control section than on the six metre grass margins, while at Greenstead Green *P. tithonus* abundance was greater on the six metre grass margins. Overall *P. tithonus* abundance significantly increased between 1997 and 2000, but there was no significant difference in *P. tithonus* abundance between establishment methods. It is suggested that to produce six metre grass margins suitable for *P. tithonus* they should be sown with a range of wildflowers and fine leaved grasses, managed by cutting the outer four metre width (adjacent to the crop) in autumn and leaving the inner two metres (adjacent to the hedge) uncut. They should be connected to other semi-natural habitats to allow for *P. tithonus* minimum habitat requirement of one to two hectares.

Introduction

Due to the dramatic transformation of arable systems since the 1940s (Dover, 1997) large areas of semi-natural grasslands have been lost (Asher *et al.*, 2001) or agriculturally improved. This has resulted in a marked reduction in the number of butterfly species that can be supported. Thomas (1984) observed that improved grassland can only support one to three species while semi-natural grassland can support 19 to 28 species. Asher *et al.* (2001) suggested that there has been a decline in butterfly distribution and abundance over the last 150 years, but this is not entirely due to changes in farming practices as climate change, urbanisation, pollution and land drainage have all played a major role.

In an attempt to reduce food surpluses and restore grassland to arable areas, grass margins around arable fields were introduced in the Countryside Stewardship Scheme (CSS). In the scheme, two types of grass margins, 2 m and 6 m, can be established. The aims for both types of margin are to buffer field boundaries, streams and rivers and provide wildlife habitats. However the establishment and management are different.

The six metre grass margins are established using a range of at least four grasses from a list provided by MAFF, with no more than 40% from one grass. The seeding rate is 20 kg/ha and where possible the seed should be native and of British origin. The six metre grass margins must be cut four times in the first year and then cut each year after 15 July with all the cuttings removed. In 1997, the farmers were paid £35 per 100 m per year for the six metre grass margins but this was reduced in 2000 to £32 per 100 m per year (MAFF, 1997).

The preferred habitat of *Pyronia tithonus* is tall grassland next to hedgerows, trees and scrub (Asher *et al.*, 2001). Thus CSS six metre grass margins could be beneficial to *Pyronia tithonus* provided that a range of larval foodplants such as *Agrostis* spp., *Festuca* spp., *Poa* spp., and *Elytrigia repens* are available, together with suitable nectar sources.

This study investigates the utilisation of six metre grass margins as set up and managed under the CSS, by *Pyronia tithonus* at two farms in Essex during the period 1997 to 2000.

Method

This study was undertaken at two farms in Essex who joined the CSS in 1996. Butterfly and plant monitoring work was undertaken at Writtle (NGR: TL 670070) and Greenstead Green (NGR: TL810288) during the period 1997-2000. Four six metre grass margins and one control section (non margin) were established at each site (Table 1), using two different seed mixtures (Table 2). At Writtle different methods were used to establish the six metre grass margins. One was sown, two were developed by natural regeneration while one was established from a grass ley. All the margins at Greenstead Green were sown.

Pyronia tithonus abundance was monitored between July and August each year using the transect method (Pollard, 1977). Monitoring was undertaken once a week, when weather conditions were suitable (Pollard and Yates, 1993), on eight six metre grass margins and at two control sections (field edges without grass margins). The total observations were summed and the number of *Pyronia tithonus* per km per visit was calculated.

The analysis of the data was completed using Mann-Whitney for comparing unmatched samples and Friedman's test for comparison of multiple samples.

Results

At Writtle there were significantly more *Pyronia tithonus* observed ($U=6$, $P<0.05$) on the control sections than on the six metre grass margins. At Greenstead Green a greater number of *Pyronia tithonus* were seen on the six metre grass margins than on the control sections, but this difference was not significant (Table 3). The abundance of *Pyronia tithonus* on the six metre grass margins was significantly greater ($U=4$, $P<0.05$) in 2000 than in 1997 (Table 4).

The six metre grass margins were established using various techniques but there was no significant difference in *Pyronia tithonus* abundance on them (Table 5). The abundance was greatest on the six metre grass margin established next to a field in permanent set-aside (G6.4), significantly more than on a nearby six metre grass margin (G6.1) which was next to arable crops ($H=10.87$, $P<0.05$) (Table 6). Both of these had been established at the same time and using the same seed mixture.

There was no significant relationship between *Pyronia tithonus* abundance and area of grass margin, length of hedgerow next to margins or abundance of larval foodplants.

Discussion

Various authors have identified that *Pyronia tithonus* abundance is associated with hedges (Dover *et al.*, 1997), tall grassland (Asher *et al.*, 2001) and field boundaries and ditches (Feber *et al.*, 1996), so one might expect CSS six metre grass margins would be beneficial to *Pyronia tithonus*. However the only really successful six metre grass margin was the one established next to the permanent set-aside. *Pyronia tithonus* abundance increased dramatically on that margin between 1998 and 2000, while only increasing slowly on the other six metre grass margins. At Writtle, *Pyronia tithonus* abundance was significantly greater on the control section than the six metre grass margin. That control section had a good range of suitable nectar and larval plants and was uncut over the research period.

Table 1. Attributes of the margins at the two farms.

	Section length (m)	Comments	Date set up
Writtle			
W6.1	631	Natural regeneration	Oct 96
W6.2	701	Natural regeneration	Oct 96
W6.3	720	From ley	Oct 96
W6.4	190	Sown mixture 1	Oct 97
WN6.5	450	No margin	
Greenstead Green			
G2.1	417	Sown mixture 2	Oct 96
G2.2	322	Sown mixture 2	Oct 96
G2.3	166	Sown mixture 2	Oct 96
G2.4	345	Sown mixture 2	Oct 96
GN2.5	250	No margin	

It is suggested that there are three main reasons why *Pyronia tithonus* abundance was not greater on the six metre grass margins. The management of the six metre grass margins did not suit *Pyronia tithonus*. The six metre grass margins were cut when *Pyronia tithonus* were just at their peak and as all the material had to be removed under CSS regulations, most of the eggs, which take 11 to 30 days to produce larvae (Porter, 1992) would have been removed with the cut material (Field, 2002). Smith *et al.* (1993) observed that for *Pyronia tithonus* summer cutting was the worst option for both sown and unsown margins in a range of trials. The best options for both sown and unsown margins were firstly uncut and then a cut in spring and autumn.

Table 2. Seed mixtures used on the six m margins at the two farms.

Seed mix	Writtle	Greenstead Green
	Mixture 1	Mixture 2
<i>Cynosurus cristatus</i>	25%	7.5%
<i>Festuca ovina</i>	15%	25%
<i>Agrostis tenuis</i>	15%	5%
<i>Festuca arundinacea</i>	12.5%	
<i>Dactylis glomerata</i>	12.5%	
<i>Alopecurus pratensis</i>	5%	
<i>Agrostis tenuis</i>	5%	
<i>Festuca pratensis</i>	5%	
<i>Festuca rubra</i> ssp. <i>commutata</i>	5%	55%
<i>Poa pratensis</i>		7.5%

Table 3. Abundance of *Pyronia tithonus* (mean number/km/visit) on the six m margins at two farms.

	Number of 6 m margins	Margin mean	Range	Control
Writtle	4			
July 1997		1.5	0-4.3	9.5
July 1998		1.5	1.1-5.4	5.8
July 1999		2.3	0-18.2	21.1
July 2000		2.9	0.7-5.9	10.6
Mean		3.6^a		11.8^b
Greenstead Green	4			
July 1997		0		
July 1998		1.2	0.5-2.2	0
July 1999		4.9	1.6-8.2	0.7
July 2000		19.3	1.8-58.7	1
Mean		6.4		0.6

Means followed by a different superscript are significantly different at $P < 0.05$, Mann-Whitney U test

There was also a lack of nectar sources for *Pyronia tithonus* on the six metre grass margins. Feber *et al.* (1996) could predict the abundance of *Pyronia tithonus* in their trials by abundance of plants such as *Knautia arvensis*, *Leucanthemum vulgare* and *Centaurea* spp., all of which were absent from all the six metre grass margins in this trial (Field, 2002). The range of grasses available as larval foodplants in all the six metre grass margins should have benefited *Pyronia tithonus* but Dover (1999) suggested that the limiting factor for butterflies in today's arable landscape is the lack of nectar sources.

Table 4. Abundance of *Pyronia tithonus* (mean number/km/visit) on the six m margins by year

	Mean abundance	Range
July 1997	1.1 ^a	0-4.3
July 1998	2.2	0.5-8.2
July 1999	5.5	0-18.2
July 2000	11.2 ^b	0.7-58.7

Means followed by different superscripts are significantly different at $P < 0.05$, Mann-Whitney U test

Table 5. Mean abundance (range) of *Pyronia tithonus* (mean number/km/visit) by establishment method

From ley	Sown	Natural regeneration	Sown next to set-aside
3.3	2.9	4.4	23.02
(0.7-4.7)	(0-9.1)	(0-18.2)	(2.2-58.7)

Table 6. Mean abundance (range) of *Pyronia tithonus* (mean number/km/visit) on sown six metre grass margin

W6.4	G6.1	G6.2	G6.3	G6.4
1.7 ^{ab}	1.3 ^a	5.2 ^{ab}	4.5 ^{ab}	23.02 ^b
(0-3.9)	(0.5-1.8)	(0.6-7.9)	(1.5-9.1)	(2.2-58.7)

Means followed by different superscripts are significantly different at $P < 0.05$, Friedman's test

One other possible problem is the minimum habitat requirement of *Pyronia tithonus*. Thomas (1984) identified that *Pyronia tithonus* needed 1 to 2 ha of suitable habitat and none of the six metre grass margins were anywhere near that required size. The best six metre grass margin for *Pyronia tithonus* was linked to an area of permanent set-aside which then meant an area of suitable habitat of over 2 ha, plus an area where all the cuttings were not removed.

To benefit *Pyronia tithonus*, six metre grass margins should be sown with a range of fine leaved grasses and wildflowers, the inner two metre (next to the hedge) should be left uncut and the other four metres should not be cut until autumn. The six metre grass margins need to be alongside hedgerows and ditches and, where possible, linked to other areas of semi-natural habitat to create large enough areas of suitable habitat.

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